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An On-line Journal for Teacher Research

Preparing Graduate Students to Teach Math: Engaging with Activities and Viewing Teaching Models

Maria Boeke Mongillo - Central Connecticut State University

Abstract

Teacher self-efficacy is the belief a teacher holds that he or she can make a difference in student achievement, even when the student is difficult or unmotivated (Guskey & Passaro, 1994). It has been linked to positive teacher practices and student outcomes. This mixed methods study of preservice elementary and early childhood math teachers explored how having students engage in hands-on activities and view video teaching models in a graduate mathematics methods course influenced their teacher self-efficacy for math. The study took place in two phases, with course modifications made between the two. Statistical analyses of pre- and post-test scores on the Mathematics Teaching Efficacy Beliefs Instrument showed positive outcomes in Phase 1 but not Phase 2. Qualitative data in both phases suggested working with hands-on materials and viewing video models was beneficial to building student self-efficacy and in improving mathematical content knowledge.

It was the first day of class in a mathematics, technology, and science methods course in a graduate teacher preparation program. Like many instructors, I took time during class to review the course syllabus, briefly discuss assignments, and explain how we would be engaging in a combination of theory and practice as we worked toward meeting the course learning outcomes. When I finished, a student's hand went up. "Are we actually going to have to *do* math?" asked the student. "Of course," I said, "This is a course about math." The class broke into concerned whispers, eye rolls, and quiet nervous laughter.

As a means of concluding class, I asked the students to complete an exit pass, to share what they were most and least excited about as we prepared to move forward in the course. Reading them after class, I saw the in-class sentiment echoed on paper. "I am awful at math," shared one student. "I am least excited about math! I am terrible at it!" said another. A third student addressed her concerns in a subtler way stating, "I am looking forward to getting more comfortable with math." While this incident reflected what happened one specific semester, I have found many students who take this course express fear or dislike of math and often share they do not feel they were successful math students.

Of additional concern to me as a math methods teacher, is many of my students go on to teach in schools where their classes include children from racial and ethnic minorities or who have lower socio-economic status. National data indicate these groups of students tend to perform well below white students or those from higher income homes on state and national math tests (National Center for Education Statistics, 2015). When I paired this with the abundance of negative comments regarding math from students, I began to be worried about how they might carry these attitudes with them into their own classrooms. I want them to help close the gap through their attitudes and instructional practices, not widen it. Consequently, these concerns led me to want to change my teaching. I began to wonder, how can teacher self-efficacy for math be raised for graduate students during the methods course? Would a combination of hands-on math activities, paired with watching video teaching models using a viewing protocol have an effect? How might increasing understandings of math content and instructional strategies contribute to an increase in teacher self-efficacy?

Framing the Study

A number of concepts shaped my thinking. First, teacher self-efficacy is the belief a teacher holds that he or she can make a difference in student achievement, even when the student is difficult or unmotivated (Guskey & Passaro, 1994). Bandura (1977, 1986, 1997) states self-efficacy is contextual, meaning a teacher can have high self-efficacy for teaching one subject, but not another. Additionally, he suggests there are four sources influencing self-efficacy beliefs, including mastery experiences, vicarious experiences, verbal feedback, and physiological changes. Thus, teacher self-efficacy is improved indirectly through engaging in positive experiences, watching others be successful, and having encouraging interactions with others.

Developing teacher self-efficacy for math is an important part of improving student outcomes. First, preservice teachers who demonstrate higher levels of personal teacher self-efficacy for math, tend to have stronger understandings of math concepts and more confidence in solving math problems (Briley, 2012). Higher levels also correlate to higher scores on tests of basic math skills (Bates, Latham, & Kim, 2011). Bursal and Paznokas (2006) state nearly half of the teachers who have high anxiety for math will not be able to teach math effectively. Thus, there appears to be a relationship among teacher self-efficacy for math, the ability to understand and actually do math, and the capacity to teach math.

Additionally, math teachers often influence their students' beliefs and attitudes toward math (Cady & Rearden, 2007). By extension, preservice teachers with higher levels of anxiety generally had lower levels of math teacher self-efficacy (Duane, Giesen, & Swars, 2006). Helping preservice teachers to shift from negative to positive attitudes regarding math may help them to avoid passing their negative outlook on math to their students (Rule & Harrell, 2006).

While the development of teacher self-efficacy is generally important because of the impact it has on teacher practices and student outcomes, it may be particularly so for United States (US) teachers at this time. The US is in the process of implementing several significant reform initiatives, with one of the more substantial being the adoption of the Common Core State Standards. Developed by state chief school officers and governors, the goal of the Common Core State Standards was to combine the best state standards and expert educator experiences to create a more consistent set of learning outcomes in math and language arts for students across the US. Previously, each state had its own set of standards and measures of proficiency. In math, one significant change the Common Core State Standards brings is a focus on process rather than algorithms. This means teachers are being asked to teach their students using methods that may be very different from the way they were taught. In times of change such as this, there is often a decrease in confidence known as the “implementation dip” as teachers adjust to new ways of teaching and learning (Fullan, 2001, p. 40). Teachers may need extra support and additional math experiences to keep their levels of self-efficacy for teaching math high as the new standards are being put into practice.

Study Methods

In approaching this action research study, I had one overarching question: how does having graduate students engage in hands-on activities and view video teaching models influence their teacher self-efficacy for math? The Dialectic Action Research Spiral, set forth by Mills (2011), suggests action research takes place in a four-step process including identifying an area of focus, collecting data, analyzing and interpreting data, and developing an action plan. According to Mills, each step informs the others in a repeating spiral, thus leading from one round of inquiry and research to another. Following this model, my study took place in two phases, with results from the first informing the second.

Phase 1 took place in a one semester, 3-credit math, science, and technology methods course in the fall of 2012, and Phase 2 in the same course in the spring of 2014, at a small private college in New York. The study phases occurred during semesters when I was teaching the methods course, thus there was a year space between the two. The math, science, and technology methods course was a required course for the students, as they were pursuing Master’s degrees in elementary or early childhood education, with the majority opting for a dual degree in special education. All of these degrees led the students to be eligible for New York State teaching certifications following the passing of several state licensure exams.

I utilized a mixed methods approach to data collection and analysis in both of the phases, in order to measure the effectiveness of the interventions, to answer the research question, and to gain a deeper understanding of what specific aspects of the interventions made them most meaningful to students.

Phase 1

Phase 1 took place in the fall semester of 2012. There were 11 female students enrolled in the methods course. The intervention for Phase 1 consisted of two parts carried out in each class. Each week covered specific math topics (number sense, place value, operations, fractions, decimals, geometry, measurement) as determined by the chapters in the course text. First, students engaged in a hands-on content review for the week’s topic. They worked as individuals or with partners, using materials that addressed topics at about the fourth grade level. The purpose of this was to provide students with opportunities to successfully engage in mastery experiences that would increase their understanding of math concepts and instructional strategies, and hopefully also raise their teacher self-efficacy. For example, for the class on geometry, student activities included the use of tangrams and pattern blocks. Students were provided a set of tangrams and the outlines of figures in which to place the tangram shapes. Likewise, they were given pattern blocks and figures to cover with the pattern blocks, or to help them explore the relationship between the different pattern block shapes (e.g., how many green triangles cover a yellow hexagon?)

Second, students watched a video of a model teacher working with children on the class's topic. The videos came from a number of websites, with the majority from Annenberg Learner in Phase 1 and the Teaching Channel in Phase 2. A list of the videos and their web addresses can be found in Appendix A. The videos showed teachers successfully using the instructional strategies we were discussing in class to support student learning. They showed teachers in different grade levels working with actual students in their classrooms. The goal of this was to provide students with vicarious experiences through viewing a successful model to increase their teacher self-efficacy for the topic of the day.

To further focus student thinking and to determine levels of teacher self-efficacy for each topic before and after viewing the video, students were provided with a viewing protocol I developed. A copy of the protocol is in Appendix B. Before viewing, students recorded how they would teach the math domain of focus. They also indicated their level of confidence for teaching the domain by selecting from a 5-point Likert scale. During the video, they recorded any ideas they saw the model teacher using that they would like to use in their own classrooms in the future. Following the video, they discussed the video with a partner, noted any other ideas for teaching, and again indicated their level of confidence.

While these activities were a key component of the 2.5 hour weekly class session, a typical class began with a short housekeeping and follow up session to address any general questions or concerns regarding assignments or other important course ideas. Generally, this was followed by an overview and discussion of the math topic being covered that week. The goal of these discussions was to clarify the concepts embedded in each topic, as well as to discuss the week's assigned readings from the course text, *Teaching mathematics to all children: Designing and adapting instruction to meet the needs of diverse learners* (Tucker, Singleton, & Weaver, 2006), or other articles. Additionally, we did an optional book share where both the students and I brought in picture books that could be used to teach the day's topic. Then, the class transitioned to the hands-on activities and the video protocol. Finally, class wrapped up with a brief look at the topic, readings, and assignments for the following week.

In addition to in-class experiences, the students completed several fieldwork assignments. First, the students were required to observe a practicing teacher during a math lesson. They recorded what the teacher said and did, and paid particular attention to how the teacher interacted with students who both did and did not appear to understand the concepts being taught. They submitted a written report of their observation for grading, plus shared their learning informally in small groups during one class. Furthermore, students designed a math lesson based on one of the methods covered in class, and taught it to students in a classroom setting. They created a formal lesson plan before teaching, and a written reflection of their teaching experience afterwards. These were the graded pieces of the project. They also brought the materials they used for the lesson and student work samples to class for informal sharing in small groups and as a "gallery walk" where students circulated the room to see everyone else's lesson supplies.

Phase 2

The Phase 2 intervention took place in the spring semester of 2014. In this semester, there were 14 students, 13 female and 1 male, enrolled in the methods course. In reflecting on student comments during Phase 1, I found I was hearing a new worry in the conversation about teaching math. Not only were students concerned about their own abilities or dislike for math, but they were apprehensive about implementing the Common Core State Standards. As a result, I redesigned the course so the class topics were aligned with the Common Core State Standard domains (counting and cardinality, operations and algebraic thinking, numbers in base ten, measurement and data, numbers and operations in factions, geometry.) Students used standards documents and other articles as the reading materials for the course.

The intervention still had its two parts consisting of hands-on activities and the viewing of video teaching models, but the content and formats of those changed. For the hands-on section, the students engaged in activities children might complete to help reach mastery of the Common Core State Standards. The activities utilized the Common Core State Standards mathematical practices. Rather than just focusing on one grade level, the students chose activities from kindergarten through grade 5, and were encouraged to try multiple activities at different levels during this class work time. Also, the students worked in partners or small groups, as the Common Core State Standards ask students to work together. In addition to mastery experiences, this provided students with verbal feedback as they talked with each other during the activities. The viewing of video models changed only slightly, in that the video topics were aligned to the Common Core State Standards. A list of these videos are also included in Appendix A. The protocol (Appendix B) remained unchanged. Students also completed the additional fieldwork assignments, the classroom observation and math lesson, as described in Phase 1.

Data Sources

Mathematics Teaching Efficacy Beliefs Instrument and post-test questions. In both Phases of the study, I asked students to complete the Mathematics Teaching Efficacy Beliefs Instrument (Enochs, Smith, & Huinker, 2000) at the beginning and end of the math section of the course. The Mathematics Teaching Efficacy Beliefs Instrument consists of 21 items on which students self-rate using a 5-point Likert scale, resulting in a score range of 21 to 105. The items factor into two subscales, one indicating Personal Teaching Mathematics Efficacy or the belief the teacher can personally make a difference in student outcomes for math, and the second reflecting Mathematics Teaching Outcome Efficacy, the belief teachers in general can impact student achievement in math. A copy of the Mathematics Teaching Efficacy Beliefs Instrument can be found in Appendix C.

To illustrate the difference between the subscales, a sample question measuring personal efficacy reads, "I understand math concepts well enough to be effective in teaching mathematics," while one measuring outcome efficacy states, "Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching." One statement references beliefs about the specific individual, while the other mentions teachers in general. Thus, outcome efficacy demonstrates the belief that teacher practices can impact student math achievement, and personal efficacy demonstrates the belief that the individual possesses the knowledge and skills necessary to carry out those positive teacher practices. On the overall scale and the subscales, higher scores indicate higher levels of teacher self-efficacy.

Additionally, during the post administrations, students were given four open-ended questions to answer. A copy of the questions are in Appendix D. The focus was on their level of teacher self-efficacy for math, how and why the level changed or did not change through course experiences, and what they thought they needed to do to continue to build their knowledge and confidence. These questions, along with the completed pre- and post-administrations of the Mathematics Teaching Efficacy Beliefs Instrument were given back to students during the final class, and used for a class discussion.

Video response protocol. Students responded on the video response protocol (Appendix B) in two different ways: through open-ended responses concerning how they would teach a specific topic in their classrooms, and by indicating their level of confidence towards teaching that concept. Both types of data were considered in determining the impact of the interventions on understandings of mathematical concepts and instructional strategies, as well as on teacher self-efficacy.

Data Analysis

In order to determine the impact of the interventions on the students' level of teacher self-efficacy for math, the quantitative data collected from the pre- and post-administrations of the Mathematics Teaching Efficacy Beliefs Instrument were analyzed using two-tailed, paired t-tests for overall score, as well as for the two subscales. All qualitative data were initially coded using a deductive process to look for evidence of how the interventions influenced teacher self-efficacy (Miles, Huberman, & Saldaña, 2014). A second round of inductive coding was used to allow other codes to surface. Once the coding was completed, the codes were categorized, grouping like codes together (Ary, Jacobs, Razavieh, & Sorensen, 2005). Through this process, underlying themes emerged as presented in the findings section below.

Findings

Phase 1

Statistical analysis. A total of 10 matching pre- and post-administration Mathematics Teaching Efficacy Beliefs Instrument pairs were available for analysis. Results from the two-tailed, paired t-test indicated a statistically significant increase ($p < .05$) for the overall Mathematics Teaching Efficacy Beliefs Instrument and the Personal Mathematics Teaching Efficacy subscale. No statistical significance was found for the Mathematics Teaching Outcome Efficacy subscale. Means and analyses are presented in Table 1.

Table 1

*Phase 1 Comparison of Pre- and Post-Test Scores on the Mathematics Teaching Efficacy Beliefs Instrument**

Scale	Pre-Test Mean	Post-Test Mean	Difference	p value
MTEBI	72.0	82.0	10.0	**0.0008
PMTE Subscale	44.5	51.8	7.3	**0.0033

MTOE Subscale	27.5	30.2	2.7	0.0557

*n = 10
**p value is significant at the .05 level (2-tailed)

Qualitative themes. Qualitative analysis revealed a positive impact on teacher self-efficacy for math in terms of four themes: general comments, hands-on activities, video viewing, and additional coursework.

General comments. Qualitative data indicated an increase in overall teacher self-efficacy for teaching math through general positive comments such as, "I feel that my confidence has increased as a result of the course," and, "I believe I have more confidence teaching math now." Some student responses, however, noted while their teacher self-efficacy had improved, their beliefs were not secure. As one student shared, "I would say [my confidence for teaching math] somewhat has [changed] because I don't fear math as much." Another indicated an even deeper concern, saying, "I think my confidence for teaching math has changed a bit. I don't know that I will ever be truly comfortable teaching it." Additional responses from students describe how strong initial levels of teacher self-efficacy may limit how much the interventions can influence beliefs. One student explained, "My confidence for teaching math has not changed as a result of this course. When I began this course, I knew and understood the concepts of math. Math is my favorite subject."

Hands-on activities. Students also provided insight into how the intervention component of hands-on activities impacted their teacher self-efficacy for math. One student shared, "My confidence for teaching math has changed. The use of manipulatives for math lessons and strategies for engaging the students in a lesson have been useful for me, as I have learned some of these skills in this course." Another stated her confidence increased because, "I have learned a variety of new ways to teach math such as with games, manipulatives, etc." Another student referred to a specific class activity, one in which students were using pattern blocks and tangrams to explore geometry concepts. She wrote, "I used the tangrams having to make the object using all seven shapes. This was very difficult and made me think and challenge my thoughts….Those tools can be used in several areas of teaching math. I enjoyed the activities."

Video viewing. Students also reflected on how the video viewing and discussion influenced their teacher self-efficacy for math. For example, one student shared, "I think I am more confident about teaching math because through watching the videos in the course, the videos taught me new suggestions and ideas when it came to teaching math." Another student stated, "The videos were really insightful on showing how math lessons are implemented in the classroom." One student even remarked she will continue to watch videos after the course to improve her practice, saying, "The most important idea I will take away with me is to watch more video clips of other lessons to motivate me. I loved [the videos]. It was very informative."

Additional coursework. Additionally, several students commented on how the additional coursework changed their thinking about teaching math. Some students referred to the math fieldwork requirement. This assignment required students to plan, teach, and reflect on a math lesson in an early childhood or elementary classroom. "[My confidence] has increased because I have actual experience teaching math now, when I didn't before." Students were also required to observe a classroom teacher in an early childhood or elementary setting teaching a math lesson. They had to report on the observed lesson, analyze the teacher's practices and success level in meeting student needs, and reflect on what strategies they would carry into their own classrooms. One student referenced the strength of the pairing of the math fieldwork assignment with the math observation assignment, stating, "Watching how others teach a math lesson and then working to make a formidable lesson of one's own is extremely useful."

Phase 2

Statistical analysis. Analysis of the Mathematics Teaching Efficacy Beliefs Instrument scores was completed using 11 pairs of pre- and post-test scores. Results from the two-tailed, paired t-test indicated no statistically significant increase ($p < .05$) for the overall Mathematics Teaching Efficacy Beliefs Instrument, or on the Personal Mathematics Teaching Efficacy and Mathematics Teaching Outcome Efficacy subscales. Of note, however, is while most students' overall Mathematics Teaching Efficacy Beliefs Instrument scores showed a change ranging from -2 to 16, with an average increase of 5.8 points, one student's score dropped 15 points. Means and analyses are presented in Table 2.

Table 2

*Phase 2 Comparison of Pre- and Post-Test Scores on the Mathematics Teaching Efficacy Beliefs Instrument **

Scale	Pre-Test Mean	Post-Test Mean	Difference	p value
MTEBI	82.7	86.3	3.6	0.1408
PMTE Subscale	46.9	50.5	3.5	0.1933
MTOE Subscale	35.8	35.8	0.0	0.7592

*n = 11

Qualitative themes. As in Phase 1, qualitative data indicate an overall improvement in the students' teacher self-efficacy for math based upon three themes, including general comments, hands-on activities, and video viewing. An additional theme regarding student concern for specific math topics and levels emerged as well.

General comments. Some students shared general comments such as, "I have a better understanding of how to teach math concepts effectively," and, "I think my confidence for teaching math has improved as a result of this course." Another student referenced the importance of the course focus on the Common Core State Standards stating, "I feel more confident with the Common Core as I understand it now. It is more process than product." Another student shared, "I CAN teach math even though I don't like it!"

Hands-on activities. Students also mentioned the intervention components in their reflections about the changes in their teacher self-efficacy throughout the course. Several students wrote about the influence of the hands-on math activities. One student stated, "I do think I have gained some confidence in teaching math. Using manipulatives and certain games helps teacher and students to learn." Another student described the activities as "a learning experience on how to solve different math problems." Working with partners was a significant part of the learning experience as well. One student described that the most important part of the course was "…the experiments/activities done as a group. This pointed out the benefits and downfalls of working with partners, particularly with instructions."

Video viewing. Likewise, students described the benefits of viewing the video models. One student shared, "The videos were a useful tool. It showed different ways to approach teaching math and gave many lesson ideas." Another student described the videos as important because, "through this course, I have seen how other teachers incorporated their own creativity in their teaching style."

Concern for topics and levels. Another emerging theme was concern for certain math topics and levels. Concerns for teaching fractions and algebra appeared many times, with the rationale for the concern being related to comfort with the concept. As an illustrative comment, one student stated, "I feel least confident teaching fractions because I am not very confident that I myself understand fractions very well." Several students also described how they felt confident teaching younger children, but were concerned about teaching older children. One student wrote, "As the math gets harder, I don't feel able to teach because as a student I was not great in math and gave up quickly when things got hard." Another shared, "I don't really like math, but I can handle early childhood math."

Further Reflection and Continuing Questions

Though the scores from both phases of the intervention on the Mathematics Teaching Efficacy Beliefs Instrument scale varied, there does seem to be promise for using math content and instructional strategies as a lever to improve the teacher self-efficacy of graduate students for math. While the scores showed a statistically significant increase for math in Phase 1, but not in Phase 2, this may be an indication of differences in the students. For math in Phase 2, a single student's score decreased from pre- to post-administration at a rate of almost 3 times the average increase of all the other students' scores. This score may have overly influenced the statistical outcomes in a negative way. Additionally, the small number of students involved in both phases may have skewed the quantitative results. I would want to try the interventions again to see the effect, and in the future I would be interested in exploring why some students see an increase and others do not.

Moreover, the differences in quantitative findings may also be related to the relationship between the interventions and teacher self-efficacy. The study interventions focused directly on increasing teacher understandings of math content and instructional strategies, through the hands-on activities, video models, and in Phase 2 interactions among students. While these align with the mastery and vicarious experiences and verbal interactions suggested to influence teacher self-efficacy (Bandura, 1977), teachers come to the classroom with previous experiences as math students themselves which are likely to shape their attitudes towards doing and teaching math. These orientations towards math, shaped over a lifetime, may be difficult to change in a few weeks of a methods course.

Reviews of the qualitative data do show some support for using the hands-on activity component to improve teacher self-efficacy for math. The majority of students expressed how working with content in small groups changed their ideas about how teachers should teach and about how students learn. This aligns with a number of previous research studies. Harrell and Rule (2006) found after taking a mathematics methods course, preservice teachers indicated working with concrete materials or manipulatives was one of the most positive experiences. This may be in part because working with manipulatives and content gave teachers an opportunity to build math concept knowledge, especially for those with poor math skills. The video portion of the intervention received direct mention in reference to teacher self-efficacy in both phases.

The hands-on experiences were also important for supporting student learning in other ways. In class discussions at the beginning of the course, students commented on how many of them were taught algorithms for math. However, comments throughout indicated their new understanding of allowing open exploration and providing opportunities for students to make meaning out of math concepts. Harkness, D'Ambrosio, and Morrone (2007) found providing preservice teachers with the opportunity to engage in this constructivist type of learning can change how they think about and view math and learning math, refocusing on the "why" of math rather than math "performance" (p. 249). This type of teaching aligns with current ideas about best instructional practices, as well as the expectations of the Common Core State Standards, and may better prepare teachers for future classroom work.

Of concern, however, are the students' attitudes about teaching math at different levels. Several students commented on how they could teach "early childhood math" or lower level math concepts, but they did not have teacher self-efficacy for more challenging topics. This attitude reflects an overall lack of understanding of math as a broader subject, and of how early math skills set the foundation for ones introduced later. This finding is of additional concern because attitudes toward teaching math appear to influence attitudes in other content areas such as science as well (Bursal & Paznokas, 2006).

Conclusion

As I reflect, I would be interested in repeating these interventions with more students, perhaps looking at the impact of the interventions on students with different educational backgrounds, particularly in math. My students had varied undergraduate experiences, with some completing a traditional 4-year degree and others a non-traditional program for adult learners, and I did not factor that in to my study. The number and type of math courses they were required to take and the focus on math for different majors may impact the attitudes and confidence levels they bring into the methods course. I also would consider revising the video intervention to make it even stronger. This may mean changing the written video protocol to include specific training in "noticing" (Star, Lynch & Perova, 2011), or having the students record, share, and analyze videos of themselves teaching, as the more closely the viewer of a video identifies with the model, the more likely it will have an impact on teacher self-efficacy (Bandura, 1977).

Additionally, I think there may be a significant role for novice teachers to play in the implementation of new standards. We often think of novice teachers needing to learn from and receive the support of veteran teachers, ultimately replicating the veterans' classroom practices. However, could novices also help to reform and support the veterans? Perhaps sending novice teachers into schools with a deep understanding of and high teacher self-efficacy for new math initiatives can in turn boost veteran teachers' teacher self-efficacy. The novices may be able to provide vicarious experiences and verbal feedback to the veterans that could limit the implementation dip described by Fullan (2001).

Preparing teachers with high levels of teacher self-efficacy for math is important because of the implications for student outcomes. Providing students the opportunity to explore and experience math using activities and watching videos may be a successful way to build teacher self-efficacy for preservice teachers, as it gives them the chance to interact with both content and pedagogy in meaningful ways.

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Appendix A
Videos Used in Class

Phase 1

Number Sense
Annenberg Learner: Ants go marching.
Retrieved from http://www.learner.org/resources/series32.html?pop=yes&pid=871

Place Value
Annenberg Learner: Place-value centers.
Retrieved from http://www.learner.org/resources/series32.html?pop=yes&pid=992

Operations
Annenberg Learner: Amazing equations.
Retrieved from http://www.learner.org/resources/series32.html?pop=yes&pid=888

Annenberg Learner: What's the price?.
Retrieved from http://www.learner.org/resources/series32.html?pop=yes&pid=888

Fractions
Teaching Channel: Fractions with borrowing.
Retrieved from https://www.teachingchannel.org/videos/fractions-with-borrowing?resume=0

Decimals
Teaching Channel: Games for decimals.
Retrieved from https://www.teachingchannel.org/videos/elementary-math-lesson-plan

Geometry
Annenberg Learner: Shapes from squares.
Retrieved from http://www.learner.org/resources/series32.html?pop=yes&pid=888

Measurement
Annenberg Learner: Pencil box staining.
Retrieved from http://www.learner.org/resources/series32.html?pop=yes&pid=888

Phase 2

Counting and Cardinality
Teaching Channel: Let's count! Learning numbers in multiple ways.
Retrieved from https://www.teachingchannel.org/videos/pre-k-math-lesson

Teaching Channel: Mingle & count: A game of number sense

Retrieved from https://www.teachingchannel.org/videos/mingle-count-a-game-of-number-sense

Teaching Channel: Counting objects and ordering numbers
Retrieved from https://www.teachingchannel.org/videos/counting-objects-and-ordering-numbers

Operations and Algebraic Thinking
Teaching Channel: Quick images: Visualizing number combinations
Retrieved from https://www.teachingchannel.org/videos/visualizing-number-combinations?fd=1

Teaching Channel: Reasoning about multiplication and division.
Retrieved from https://www.teachingchannel.org/videos/multiplication-division-in-the-core

Teaching Channel: Chessboard algebra and function machines.
Retrieved from https://www.teachingchannel.org/videos/algebra-lesson-planning

Numbers in Base Ten
Teaching Channel: Leprechaun traps: Addition within 100.
Retrieved from https://www.teachingchannel.org/videos/grade-1-math?fd=1

Teaching Channel: Games for decimals.
Retrieved from https://www.teachingchannel.org/videos/elementary-math-lesson-plan

Measurement and Data
Teaching Channel: Graphing with colors.
Retrieved from https://www.teachingchannel.org/videos/3rd-grade-graphing-lesson?fd=1

Teaching Channel: The Iditarod and math.
Retrieved from https://www.teachingchannel.org/videos/technology-and-math

Numbers and Operations in Fractions
Teaching Channel: Multiplying whole numbers & fractions.
Retrieved from https://www.teachingchannel.org/videos/multiplying-fractions-by-whole-numbers-lesson?fd=1

Geometry
Annenberg Learner: Shapes from squares.
Retrieved from http://www.learner.org/resources/series32.html?pop=yes&pid=888

Appendix B
Sample Video Response Protocol

Number Sense

Before Video:
How might you teach the topic of Number Sense to your students?

How confident are you that you could teach the topic of Number Sense to your students?

Very Confident Confident Neutral Not Very Confident Not at All Confident

After Video:
What are some ideas from that video that you might use to teach the topic of Number Sense to your students?

Discuss your ideas with a partner. Add any additional ideas you have for teaching Number Sense to students.

How confident are you that you could teach the topic of Number Sense to your students?

Very Confident Confident Neutral Not Very Confident Not at All Confident

Appendix C

Mathematics Teaching Efficacy Beliefs Instrument
(Enochs, Smith, & Huinker, 2000)

Please indicate the degree to which you agree or disagree with each statement below by circling the appropriate letters to the right of each statement.

SA	A	UN	D	SD
Strongly Agree	Agree	Uncertain	Disagree	Strongly Disagree

1. When a student does better than usual in mathematics, it is often because the teacher exerted a little extra effort.	SA	A	UN	D	SD
2. I will continually find better ways to teach mathematics.	SA	A	UN	D	SD
3. Even if I try very hard, I will not teach mathematics as well as I will most subjects.	SA	A	UN	D	SD
4. When the mathematics grades of students improve, it is often due to their teacher having found a more effective teaching approach.	SA	A	UN	D	SD
5. I know how to teach mathematics concepts effectively.	SA	A	UN	D	SD
6. I will not be very effective in monitoring mathematics activities.	SA	A	UN	D	SD
7. If students are underachieving in mathematics, it is most likely due to ineffective mathematics teaching.	SA	A	UN	D	SD
8. I will generally teach mathematics ineffectively.	SA	A	UN	D	SD
9. The inadequacy of a student’s mathematics background can be overcome by good teaching.	SA	A	UN	D	SD
10. When a low-achieving child progresses	SA	A	UN	D	SD

in mathematics, it is usually due to extra attention given by the teacher.					
11. I understand mathematics concepts well enough to be effective in teaching elementary mathematics.	SA	A	UN	D	SD
12. The teacher is generally responsible for the achievement of students in mathematics.	SA	A	UN	D	SD
13. Students' achievement in mathematics is directly related to their teacher's effectiveness in mathematics teaching.	SA	A	UN	D	SD
14. If parents comment that their child is showing more interest in mathematics at school, it is probably due to the performance of the child's teacher.	SA	A	UN	D	SD
15. I will find it difficult to use manipulatives to explain to students why mathematics works.	SA	A	UN	D	SD
16. I will typically be able to answer students' questions.	SA	A	UN	D	SD
17. I wonder if I will have the necessary skills to teach mathematics.	SA	A	UN	D	SD
18. Given a choice, I will not invite the principal to evaluate my mathematics teaching.	SA	A	UN	D	SD
19. When a student has difficulty understanding a mathematics concept, I will usually be at a loss as to how to help the student understand it better.	SA	A	UN	D	SD
20. When teaching mathematics, I will usually welcome student questions.	SA	A	UN	D	SD
21. I do not know what to do to turn students on to mathematics.	SA	A	UN	D	SD

Appendix D

Open-Ended Questions for Post Scale Administration

1. Do you think your confidence for teaching math has changed as a result of this course? If so, in what ways?

2. If the professor teaches this course again, which activities and assignments would you recommend that she keep? Why?

3. Which activities and assignments would you recommend that she remove? Why?

4. In order for you to continue to build your confidence for teaching math, what do you need to do either on your own or with the help of the professor?